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(54) **Triangular section lattice girder**

(57) A triangulated girder used for underground working comprising two base stringers 1, 2 and a larger diameter apex stringer 3 has one or more connecting elements (4, Fig. 1) 5 for increasing the buckling strength. The connecting element 5 comprises a plurality of iron bars and is welded to the stringers 1, 2, 3 inwardly of the prism formed by the stringers 1, 2, 3. The connecting element 5 in some embodiments has the shape of two triangles which are connected to one another at a corner 43, 53 and are thereby connected to the apex stringer 3, the base of one triangle 41, 51 and that 45, 55 of the other triangle are welded to the base stringers 1, 2 at a distance from one another. The distance between two adjacent connecting elements 5, 5′ determines the buckling strength of the girder. Even when the connecting elements 5, 5′ are arranged close together, the weld locations 46, 56, 47, 57, 48 are positioned such that the stringers 1, 2, 3 are not weakened by altering the arrangement.

Fig. 2

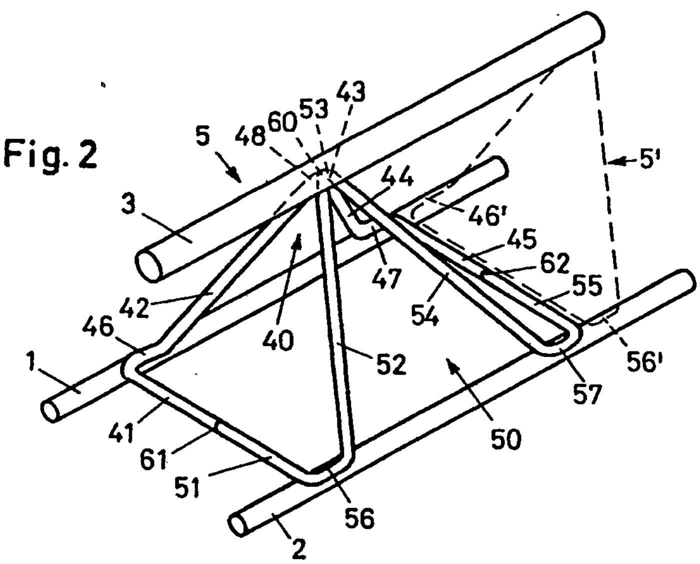

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Fig.1

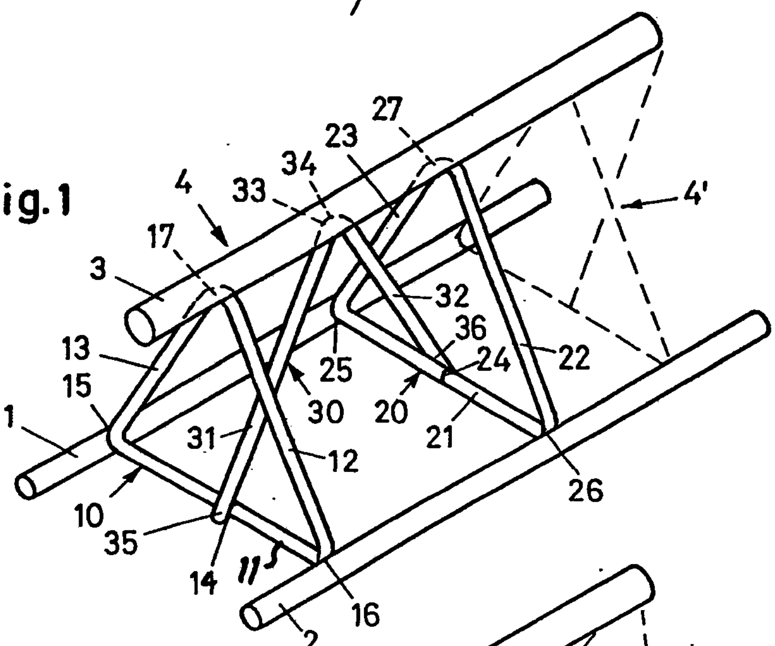


Fig. 2

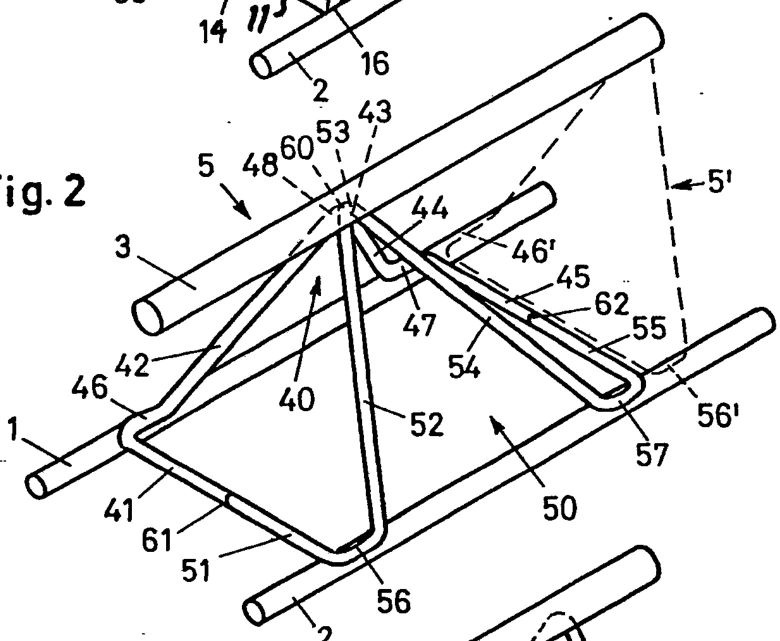
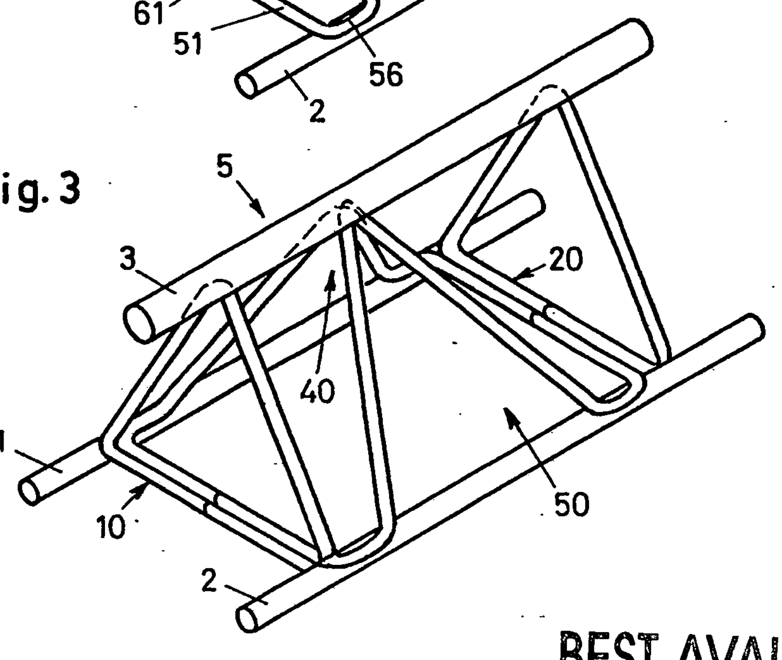


Fig. 3



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SPECIFICATION

Improved lattice girder

The present invention relates to an improved lattice girder with a connecting element for underground road or shaft working.

In constructing underground excavations, arch supports are installed for supporting the arch after each tunnelling or boring advance, which arch supports facilitate free passage and are afterwards embedded in concrete. Because of the use of sprayed concrete, lattice girders are being increasingly used because they do not exhibit a spray shadow or shielded area that the sprayed concrete cannot reach, in contrast to I-girders, T-girders or U-girders, and therefore a uniform concrete layer or mass is achieved or made possible. Such lattice girders are known, for example, from EP-B-73,733.

The disadvantage of existing lattice girders is that the elements connecing them together have to be pushed closer together to increase the effective length so that, in the extreme case, they contact each other without an intervening space. However, increasing the breaking strength is only possible by increasing the buckling strength. If the connecting elements are arranged close together, the weld locations also lie closely together. Closely located welds can have an undesired effect on the structure of the steel, as brittle locations may be produced relatively close together in the stringers of the girder. This weakens the lattic girder.

It is therefore an object of the present invention to create a lattice girder having a connecting element with which the strength can be achieved both via the effective length and by a simple reinforcement and without having to bring the weld locations close to one another.

According to the present invention there is provided a lattice girder for underground road and shaft working, said lattice girder having three parallel stringers of which two base stringers are of smaller diameter than the apex stringer and a connecting element which is welded to the stringers, in each case on the inside of the triangle defined by said stringers, in which said connecting element comprises at least two triangular spacers.

The invention will now be further described by way of examples with reference to the accompanying drawings, in which:

Fig.1 is a perspective view of a triangulated girder having a connecting element according to a first embodiment;

Fig.2 illustrates a similar representation of a triangulated girder as in Fig.1, but with a second embodiment of a connecting element; and

Fig.3 illustrates a similar representation of a triangulated girder with a combination of the connecting elements according to Figs. 1 and 2.

In spatial position, three parallel stringers 1, 2, 3 form the corners of a three-sided prism. Two base stringers 1 and 2 are of a smaller diameter than an apex stringer 3. During installation, the apex stringer 3 can be arranged to face towards the exposed rock-face and the two base stringers 1 and 2 can be arranged to face inwardly, so that the apex stringer 3 is subjected to tensile and compressive stress and the two base stringers are then accordingly likewise subjected to tensile and compressive stress. Installing the other way round is also possible. By appropriate dimensioning, triangulated girders can be inserted in this way into various underground structures. The connecting elements form an important part of the structure, because on the one hand they transmit the force between the three stringers and on the other hand they establish the effective length of the stringers.

According to the embodiment of Fig.1, a connecting element 4 consists of two spacers 10,20 of triangular configuration which, with three weld locations each 15, 16, 17, and 25, 26, 27 respectively, are rigidly connected to inner faces of the stringers 1, 2, 3. Spacers 10, 20 are formed by bars 12, 13, 22 and 23 bent to form triangles, and are welded together at the locations 14, 24 located centrally between the base stringers 1, 2. It can be ascertained by static analysis that the extending between bar parts 11, 21 stringers 1 and 2 and containing joints 14 and 24 do not in practice transmit any forces and are therefore unloaded.

The buckling strength of such a girder can be increased by reducing the effective length, that is the length between two supporting locations. According to the proposal, a reinforcement insert 30 is then used. For this purpose, a bar bent at an angle has its apex 34 welded to the apex stringer 3 by means of a weld 33. The ends 35 and 36 of the two legs 31, 32 of insert 30 are welded to the weld locations 14, 24 of the bar parts 11, 21, that is, centrally between the base stringers 1, 2. Therefore, for each connecting element 4 there are seven weld locations on the stringers 1, 2, 3, viz. 15, 16, 17, 25, 26, 27 and 33.

An adjacent connecting element 4′ can be spaced at a distance from the afore-mentioned connecting element 4, which distance is in accordance with the buckling strength demanded. In this case, three important differences are to be considered:

1. The distance from the adjacent spacer of the adjacent connecting element 4′ to the spacer 20 is the same as the distance between the spacers 10,20 of the connecting element 4. Therefore a further reinforcement insert 30 (not shown) can be inserted between the two adjacent connecting elements 4, 4′.

2. The adjacent connecting element 4′ is

connected without a space between it and the preceding connecting element 4. This results in a minimum effective length, and the spacer weld locations on each stringer are in each case common to the adjacent spacers of the adjacent connecting elements 4, 4'.

3. The adjacent connecting elements are separated by a distance greater than their length. The spacer weld locations of connecting element 4 on the stringers 1, 2, 3 are located at a distance from the spacer weld locations of connecting element 4' on the stringers 1, 2, 3, which is hardly able to effect the strength of the stringers.

According to the embodiment shown in Fig.2, two spacers of connecting element 5 comprise the bar parts 41, 42, 51, 52 and 44, 45, 54, 55 and are arranged at least in planes which enclose approximately the same angles to the stringers 1, 2, 3 as the reinforcement bar 30 in the example described above. The connecting element 5 comprises a half section 50 which comprises bar parts 51, 52, 53, 54, 55, 56, 57 and a half section 40 which comprises bar parts 41, 42, 43, 44, 45, 46, 47. The two halves 40, 50 have an identical shape and are welded centrally between the base stringers 1, 2 at weld locations 61, 62, that is at locations which, as stated, are hardly stressed. Both halves 40, 50 are connected to the apex stringer 3 at a common weld location 60.

In such an embodiment of the connecting element 5, the effective length can also be readily varied between the three values described hereinbefore. In the extreme case (3), the adjacent connecting elements 5 and 5' are in contact, so that the adjacent weld locations 46', 47 and 56', 57 coincide.

The embodiment according to Fig.3 is a combination of the two embodiments according to Figs. 1 and 2. The connecting element 5 according to Fig.2 is located inbetween the two spacers 10,20 according to Fig.1. In other words, the reinforcement insert 30 of Fig.1 is replaced by the connecting element 5 of Fig.2.

If the embodiment according to Fig.3 is selected and the effective length or spacing outlined in (1) above is required, then only one reinforcement insert 30 according to Fig.1 is included and is welded in a position between two adjacent connecting elements 5,5'.

CLAIMS

1. A lattice girder for underground road and shaft working, said lattice girder having three parallel stringers of which two base stringers are of smaller diameter than the apex stringer and a connecting element which is welded to the stringers, in each case on the inside of the triangle defined by said stringers, in which said connecting element comprises at least two triangular spacers.

2. A lattice girder as claimed in claim 1, wherein said triangular spacers lie in planes which are perpendicular to all three said stringers.

3. A lattice girder as claimed in claim 2, wherein said triangular spacers are arranged in pairs and a reinforcement insert, bent at an angle is located centrally between said base stringers, with its leg ends fixed to said triangular spacers and with its apex fixed to the apex stringer.

4. A lattice girder as claimed in claim 1, wherein said triangular spacers are arranged in planes inclined in opposite directions relative to the base plane defined by the axes of the base stringers.

5. A lattice girder as claimed in claim 4, wherein said planes intersect the base plane at diametrically opposite angles.

6. A lattice girder as claimed in claim 5, wherein said planes intersect the apex stringer at least approximately at the same point.

7. A lattice girder as claimed in claim 6, wherein said triangular spacers are connected to one another at their sections located on the apex stringer.

8. A lattice girder as claimed in any one of claims 1 to 7, wherein said triangular spacers are formed from a bar of reinforcing steel, and the ends of said bar are connected to one another at a location between the base stringers.

9. A lattice girder as claimed in claim 1, wherein said connecting elements are separated by a distance determined in accordance with the effective length.

10. Lattice girders substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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